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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/534,946	05/11/2005	Takashi Yokoyama	94326	3657

24628 7590 09/05/2008

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1792	

MAIL DATE	DELIVERY MODE
09/05/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/534,946	YOKOYAMA ET AL.	
	Examiner	Art Unit	
	MATTHEW J. SONG	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 June 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *19,21,24 and 25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *19,21,24 and 25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/19/2008 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 24-25 are rejected under 35 U.S.C. 102(b) as being anticipated by Nakamura et al (WO 01/71069 A1), where US 6,869,478 is used as an accurate English Translation.

Nakamura et al teaches producing a defect free crystal where defect free means no voids defects, nor oxidation induced stacking faults or dislocation clusters ('478 col 14, ln 1-40). Nakamura et al also teaches a wafer being defect free (col 21, ln 35-67), this reads on applicant's no OSF and an average void defect density of not more than $5x10^6/cm^3$ and an average void defect size not more than 100 nm because the ranges encompass a void density of zero.

Referring to claim 25, Nakamura et al teaches the entire wafer is defect free.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura et al (WO 01/71069 A1), where US 6,869,478 is used as an accurate English Translation, in view of Falster et al (US 2002/0121238 A1).

Nakamura et al teaches producing a defect free crystal where defect free means no voids defects, nor oxidation induced stacking faults or dislocation clusters ('478 col 14, ln 1-40). Nakamura et al also teaches a V/G at which a defect free region occurs (col 10, ln 1-15). Nakamura et al also teaches a graphing defects as pulling rate is changed to determine the

optimal pulling rate for producing a defect free crystal for a particular G. (See Figure 8 and col 20, ln 1-67).

Nakamura et al does not teach setting a carbon concentration to $1x10^{15}$ atoms/cm^3 or less.

In a method of forming silicon single crystals, note entire reference, Falster et al teaches carbon present as an impurity in a single crystal silicon is preferably less than $5x10^{15}$ atoms/cm^3 ([0163]), overlapping ranges are held to be *prima facie* obvious (MPEP 2144.05). Falster et al also teaches carbon has the ability to catalyze into oxygen precipitate nucleation centers so it is preferred to keep carbon low ([0163]).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nakamura et al by having a low carbon concentration, as taught by Falster et al, within the claimed range because carbon produces defects thus less carbon is desirable to produce fewer defects.

In regards to the limitation "setting a carbon concentration to $1x10^{15}$ atoms/cm^3 or less for suppressing occurrence of the dislocation clusters, thereby expanding an allowable range of a growth condition V/G in which a defect free crystal can be produced, and adjusting the growth condition V/G within the expanded allowable range", the combination of Nakamura et al and Falster et al teaches setting a carbon concentration to $5x10^{15}$ atoms/cm^3 or less which overlaps the claimed range, and varying pulling rate to determine a V/G for producing a defect free crystal. The fact that applicant has recognized another advantage (expanding an allowable V/G range) which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

6. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shimanuki et al (US 5,900,059) in view of Falster et al (US 2002/0121238 A1) and Nakamura et al (WO 01/71069 A1), where US 6,869,478) is used as an accurate English translation.

In a method of growing silicon single crystals in a Czochralski process, note entire reference, Shimanuki et al teaches a graphite crucible **18** that covers an outside of a quartz crucible **14**; and a heat shield **22** that is disposed above the quartz crucible and the graphite crucible for guiding a carrier (inert) gas to a melt surface inside the quartz crucible, in which the silicon single crystal is pulled from the melt inside the crucible and the heat shield is arranged to be raised or lowered. (Col 1, ln 10-67 and Fig 8). Shimanuki et al also teaches melting polycrystalline silicon (col 1, ln 25-40) and the heat shield is at a position where a distance between an upper end of the heat shield and an inner wall of the pulling chamber is 0 mm (See Fig 8 where the shield **22** is attached to inner wall, thus 0 mm distance).

Shimanuki et al does not teach setting a carbon concentration to $1x10^{15}$ atoms/cm^3 or less.

In a method of forming silicon single crystals, note entire reference, Falster et al teaches carbon present as an impurity in a single crystal silicon is preferably less than $5x10^{15}$ atoms/cm^3 ([0163]), overlapping ranges are held to be *prima facie* obvious (MPEP 2144.05). Falster et al also teaches carbon has the ability to catalyze into oxygen precipitate nucleation centers so it is preferred to keep carbon low ([0163]).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Shimanuki et al by setting a carbon concentration to $1x10^{15}$ atoms/cm^3 or less as taught by Falster et al to prevent the formation of oxygen precipitate nucleation centers.

Falster et al does not teach positioning the heat shield where a carbon concentration inside the pulled crystal is $3x10^{15}$ atoms/cm^3.

The combination of Shimanuki et al and Falster et al does not teach pulling up the silicon single crystal while a growth condition V/G is adjusted with a defect free allowable range such that void defects, OSFs and dislocation clusters are eliminated from the pulled silicon single crystal.

Nakamura et al teaches producing a defect free crystal where defect free means no voids defects, nor oxidation induced stacking faults or dislocation clusters ('478 col 14, ln 1-40). Nakamura et al also teaches a V/G at which a defect free region occurs (col 10, ln 1-15). Nakamura et al also teaches a graphing defects as pulling rate is changed to determine the optimal pulling rate for producing a defect free crystal for a particular G. (See Figure 8 and col 20, ln 1-67).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Shimanuki et al and Falster et al to adjust the V/G ratio to produce a defect crystal, as taught by Nakamura et al, to produce a defect free crystal.

In regards to the limitation "setting a carbon concentration to $1x10^{15}$ atoms/cm^3 or less for suppressing occurrence of the dislocation clusters, thereby expanding an allowable range of a growth condition V/G in which a defect free crystal can be produced, and adjusting the growth condition V/G within the expanded allowable range", the combination of Shimanuki et al, Falster

et al and Nakamura et al teaches setting a carbon concentration to $5x10^{15}$ atoms/cm^3 or less which overlaps the claimed range, and varying pulling rate to determine a V/G for producing a defect free crystal. The fact that applicant has recognized another advantage (expanding an allowable V/G range) which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

In regards to the position of the upper end of the heat shield and the inner wall being 0-30 mm, thereby suppressing flow of CO gas to the melt, the CO gas being generated by a reaction between the quartz crucible and the graphite crucible which passes through the upper end of the heat shield and the inner wall of the single crystal pulling chamber, Shimanuki et al teaches a heat shield attached the inner chamber thus a distance of 0 mm; therefore the effect of suppressing CO flow is expected.

Response to Arguments

7. Applicant's arguments with respect to claims 19, 21, and 24-25 have been considered but are moot in view of the new ground(s) of rejection.

8. Applicant's arguments filed 6/19/2008 have been fully considered but they are not persuasive.

Applicant's argument that Falster et al teaches setting a carbon concentration to prevent the formation of oxygen precipitates, not to expand an acceptable range of the V/G condition is noted but not found persuasive. The fact that applicant has recognized another advantage which

would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). Nakamura et al teaches varying a pulling rate to determine the V/G for pulling a defect free single crystal and Falster et al teaches a carbon concentration which overlaps the claimed range; therefore the fact that the V/G range would be expanded would have flowed naturally from the combination of Nakamura et al and Falster et al.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Borgini et al (US 2002/0179006 A1) teaches a wafer may have an oxygen concentration falling anywhere within the range attainable in a CZ process, which is typically about $5x10^{17}$ to about $9x10^{17}$ atoms/cm^3 or about 10 to about 18 ppma ([0022]).

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MATTHEW J. SONG whose telephone number is (571)272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Kornakov can be reached on 571-272-1303. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
August 29, 2008

/Robert M Kunemund/
Primary Examiner, Art Unit 1792